

# OPTIMIZING THE USE OF AQUACEL AG® FOR PEDIATRIC BURNS - WHEN TO START?

## OPTIMISATION DE L'EMPLOI D'AQUACEL AG® DANS LES BRÛLURES DE L'ENFANT : QUAND DÉBUTER ?

Kruchevsky D.,<sup>✉</sup> Pikkel Y., Mattar S., Ramon Y., Ullmann Y.

Department of Plastic and Reconstructive Surgery, Rambam Health Care Campus, Haifa, Israel

**SUMMARY.** Most pediatric burns are 2nd degree partial thickness, and most will heal spontaneously by providing a good healing environment, though there is no standardized treatment protocol. Aquacel Ag® has shown good clinical results in reducing the need for frequent dressing changes in the pediatric population. This study's goal was to review our experience using this dressing for pediatric partial thickness burns in order to optimize and customize its use. A retrospective study included all pediatric patients suffering from burns, admitted to our institution between July 2013 and May 2018. We investigated a total of 705 dressing changes in our cohort of 276 patients. The most prevalent dressing material was Aquacel Ag®, used in 48% of cases. We examined the pattern of using Aquacel Ag® dressings. The average time until dressing change was required proved to be much longer when applied on the 1st day after burn and onward in comparison to the day of injury (4.85 vs. 2.21 days,  $p < 0.001$ ). Moreover, when it was applied on the 1st day after burn, a dressing used on a superficial 2nd degree burn needed to be changed less often than when it was applied on a deep 2nd degree burn (4.95 vs. 2.29 days,  $p = 0.024$ ). To optimize its use and cost effectiveness, dressing with Aquacel Ag® should be initiated on the 1st day after burn, or on the 2nd day when a deep 2nd degree burn is suspected; until then a standard topical preparation should be used.

**Keywords:** pediatric burns, aquacel AG®, burn dressing, hydrofiber dressing

**RÉSUMÉ.** La plupart des brûlures de l'enfant sont des brûlures du 2e degré intermédiaire et cicatriseront spontanément si les conditions locales sont favorables. Cependant il n'y a pas de protocole standardisé. Aquacel AG® a montré de bons résultats cliniques tout en réduisant la fréquence de réfection des pansements dans la population pédiatrique. Le but de cette étude est de faire le point sur notre expérience avec ce pansement pour les brûlures de 2e degré intermédiaire de l'enfant afin d'optimiser et de standardiser son utilisation. Tous les enfants admis dans notre institution pour brûlures entre juillet 2013 et mai 2018 ont été inclus de façon rétrospective. Nous avons repris un total de 705 réfections de pansement sur notre cohorte de 276 patients. Le pansement utilisé le plus souvent était Aquacel AG®, dans 48% des cas. Nous avons étudié les modalités d'utilisation du pansement Aquacel AG®. Le délai moyen dans lesquels il était nécessaire de refaire le pansement s'est révélé être bien plus long lorsque la première application d'Aquacel AG® avait lieu le lendemain de l'accident où les jours suivants comparativement à l'application le jour de l'accident (4,85 vs 2,21 jours,  $p < 0,001$ ). De plus, lorsque le pansement était appliqué le lendemain de l'accident, la fréquence des changements ultérieurs était moins importante pour le 2e degré superficiel que pour le 2e degré profond (4,95 versus 2,29 jours,  $p < 0,024$ ). Pour optimiser son utilisation et la balance coût/efficacité, le pansement Aquacel AG® doit être appliqué le lendemain d'une brûlure de 2e degré superficiel et le surlendemain si on craint une brûlure de 2e degré profond. Entre-temps, un pansement classique sera utilisé.

**Mots-clés :** brûlures de l'enfant, Aquacel AG®, pansement de brûlure, pansement hydrocellulaire

<sup>✉</sup> Corresponding author: Dani Kruchevsky. Tel.: +972 529276619; fax: +972 47772611; email: d\_kruchevsky@health.rambam.gov.il  
Manuscript: submitted 11/12/2019, accepted 07/01/2020

## Introduction

Children are disproportionately affected by burn injuries, most of which are 2<sup>nd</sup> degree partial thickness, caused by scalding as the leading mechanism.<sup>1-4</sup> Most partial degree burns will heal spontaneously just by avoiding infection and deepening of the burn. Various treatment options have been proposed, but there is no standardized treatment protocol.<sup>5,6</sup>

An ideal dressing should provide a good healing environment, a moisturized environment with antibacterial properties, without interference to tissue healing, be cost effective, and be easy to use without the need for frequent changes, which is especially important for the pediatric population.

Aquacel Ag<sup>®</sup> (ConvaTec, Princeton, NJ, USA) is a nonwoven sodium carboxymethylcellulose impregnated with 1.2% ionic silver, which has been shown in vitro and in clinical studies to possess most of the above qualities.<sup>7-14</sup> Among children suffering from partial thickness burns, this dressing has been shown to be effective by reducing painful dressing changes, nursing time and length of hospitalization, thus reducing the cost of treatment despite the higher cost per dressing unit.<sup>15-20</sup>

This study's goal was to review our experience using this dressing for pediatric partial thickness burns in order to optimize and customize its use.

## Patients and methods

This study was approved by the institutional Ethics Committee. It is a retrospective study including all pediatric patients up to the age of 16 admitted to our institution, which serves as a referral center for pediatric burns in the north of Israel. This study included children admitted between July 2013 and May 2018, all suffering from partial degree burns. Those suffering from full thickness burns and patients who presented to our institution more than 48 hours after burn injury were excluded.

Medical records were reviewed regarding demographic information (i.e. age, gender, place of residence), burn characteristics (e.g. mechanism, surface area injured, suspected degree, body parts injured etc.), hospitalization details (e.g. length of stay, sepsis episodes, treatment, dressings used and frequency of replace-

ment, etc.) and follow up (time to closure and scarring).

Student's T-test was applied for continuous variables. Chi-square test was used for categorical variables analysis. Pearson correlations were applied for examining correlations between continuous variables. P-value of 5% or less was considered statistically significant. The data were analyzed using the SPSS version 23 (SPSS Inc. Chicago, IL, USA).

## Results

Our search yielded 276 admissions of children in the years 2013-2018. Of those, 34 patients suffered from 3<sup>rd</sup> degree burns, thus were excluded. Eight patients were transferred from other hospitals, admitted to our institution more than 48 hours post injury with an incomplete clinical data, therefore were also excluded from the study. Our final study group included 234 patients.

Fifty-nine percent of the cohort were male. Sixteen percent were less than one year old, 60% were 1-3 years old, 12% were 4-6 years old, and 12% were older than 6. The majority had scald injuries (85%), while 9% were injured by contact burn, 5% by direct fire and 1% by another mechanism. The injured TBSA (total body surface area) was on average 8.48% and length of hospitalization was 5.97 days (*Table I*).

**Table I** - Characteristics of the cohort

	n.	234
<b>Age</b>	Mean	3.29
	STD	3.59
<b>Gender</b>	Male	145
	Female	89
<b>TBSA</b>	Mean	8.48
	STD	6.34
<b>Degree of burn</b>	2nd sup.	156
	2nd deep	78
<b>LOS</b>	mean	5.97
	STD	5.43
<b>TTC</b>	mean	28.68
	STD	27.63
<b>Mechanism of burn</b>	Scald	198
	Fire	17
	Contact	20
	Other	2

STD = standard deviation; TBSA = total body surface area; 2nd Sup. = 2nd degree superficial burn; LOS = length of stay; TTC = time to closure

We investigated a total of 705 dressing changes in our cohort. The most prevalent dressing material was Aquacel Ag®, a hydrofiber dressing impregnated with silver ions, for a total of 48% of our patients. Silver sulfadiazine was used for 24% of cases, Granuflex® membrane for 11%, Flaminal® for 9% and hypochlorite solution (Eusol) was used for 2% of cases. Nine percent of the patients were treated with vaseline ointment only, since the burn was confined to the face area.

Observing the pattern of using Aquacel Ag® dressings, the average time until a change was needed due to excessive secretion was much longer when applied on the 1<sup>st</sup> day after burn and onward in comparison to when it was applied on the day of injury, 4.85 and 2.21 days respectively,  $p < 0.001$  (Fig. 1).

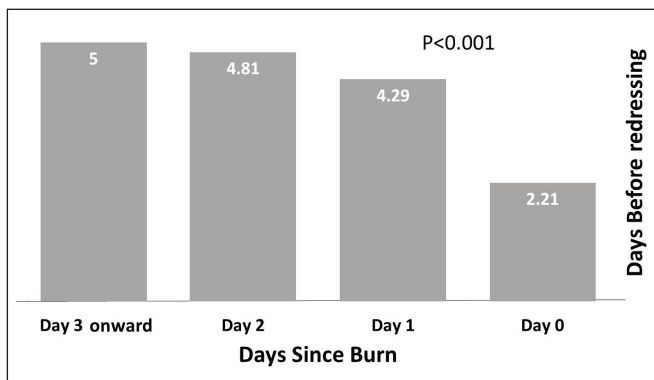


Fig. 1 - Days to redressing with Aquacel Ag® by days after burn

The characteristics of the patients who were treated with Aquacel Ag® dressings on the day of burn or after were comparable (Table II).

Furthermore, when examining the variables that could affect the effectiveness of the hydrofiber dressings, we observed that when applying the dressing on the 1<sup>st</sup> day after burn, a dressing used on a deep 2<sup>nd</sup> degree burn needed to be changed more often than when it was applied on a superficial 2<sup>nd</sup> degree burn on 2.29 and 4.95 days respectively,  $p = 0.024$  (Fig. 2). Characteristics of the patients who were treated with hydrofiber dressings on the 1<sup>st</sup> day after burn divided by the assessed degree of burn are reported in Table III. On the 2<sup>nd</sup> day after burn and afterwards, no significant difference was noticed as regards time until a change of dressing was needed (Fig. 2).

Table II - Dressing with Aquacel Ag® on the day of burn vs. the day after burn

		D0	D>0	P
n.		25	184	
Age	Mean	1.78	2.75	0.1
	STD	2.12	3.18	
Gender	Male	15	101	0.59
	Female	10	83	
TBSA	Mean	10.08	9.5	0.64
	STD	5.72	6.04	
No. of areas	Mean	3.16	3.11	0.86
	STD	1.18	1.43	
LOS	Mean	7.76	6.53	0.31
	STD	5.61	5.2	
Degree of burn	2nd Sup.	14	94	0.50
	2nd Deep	11	90	
DR	Mean	2.21	4.85	<0.001
	STD	1.38	4	

STD = standard deviation; TBSA = total body surface area; LOS = length of stay; 2nd Sup. = 2nd degree superficial burn; DR = days to redressing

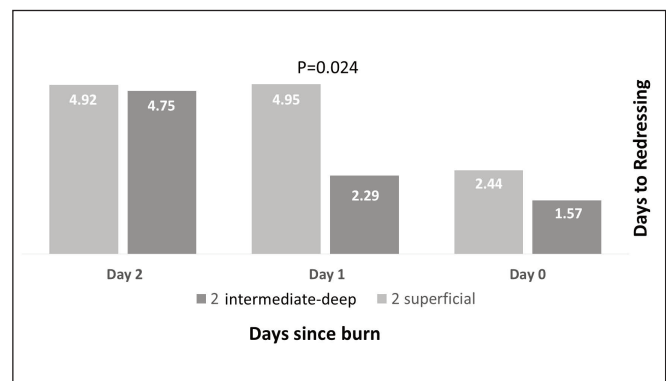


Fig. 2 - Days to redressing by days after burn and by degree of burn

Table III - Characteristics of patients dressed with Aquacel Ag® on the day after burn divided by assessed degree of burn

		2 superficial	2 -deep	p value
n.		40	28	
Age	Mean	3.03	2.64	0.21
	STD	3.28	3.08	
Gender	Male	26	11	0.036
	Female	14	17	
TBSA	Mean	8.73	9.45	0.29
	STD	5.10	5.47	
Time to closure	Mean	25.61	33.96	0.50
	STD	34.74	14.81	
LOS	Mean	5.28	8.27	0.050
	STD	4.13	6.75	
DR	Mean	4.95	2.29	0.024
	STD	5.25	1.87	

STD = standard deviation; TBSA = total body surface area; LOS = length of stay; DR = days to redressing

## Discussion

Partial thickness burns are expected to heal spontaneously when provided with an optimal healing environment and by preventing infection.

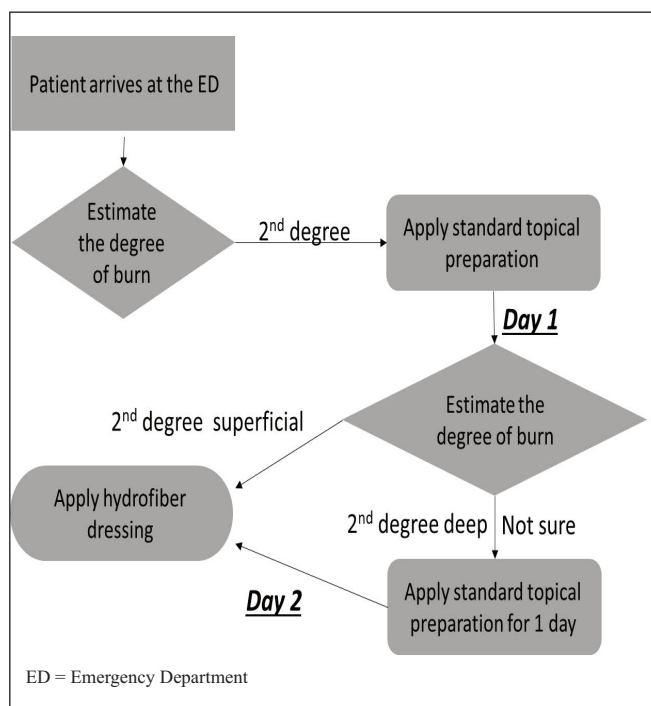
Aquacel Ag® dressing combines the properties of hydrofiber material, which absorbs wound exudates to form a gel, allowing a good healing environment and reducing the need for repeated dressing changes<sup>13</sup> with the gradual and prolonged release of silver ions, known for their antibacterial effect against a wide range of bacteria, yeast and fungi with low resistance.<sup>21-23</sup>

The advantages of this dressing include: good adherence to the wound surface, reduced need for dressing changes, and decreased nursing time and hospital stay. All this makes the dressing particularly suitable for pediatric patients in whom these advantages are even more beneficial.<sup>15-20</sup>

In this study, Aquacel Ag® has been the most used dressing for pediatric burns in our institution. The average dressing change frequency was every 4.02 days, comparable with previous studies.<sup>9,10,15-20</sup> However, the dressing was less effective when used on the day of burn and the 1<sup>st</sup> day afterwards for those suffering from deeper partial thickness burn, in terms of redressing: 2.21 and 2.29 days, respectively.

The cost of using Aquacel Ag® is higher than the topical preparations, but when calculating and comparing to total treatment cost, Aquacel Ag® was shown to be more cost effective due to a reduction in redressing procedures, nursing time and hospital length of stay.<sup>16,19,20</sup> Our lesson from this study is that using hydrofiber dressing such as Aquacel Ag® is beneficial when not applied on the same day of injury, because the need for dressing change is significantly shorter. It is always better to begin with a cheaper preparation, and only after a day or two to start using it, when we are certain about injury depth. When the injury is diagnosed as deep 2<sup>nd</sup> degree, using Aquacel Ag® should be postponed until two days post injury because if used any earlier, a higher frequency of redressing is needed. Nevertheless, when 3<sup>rd</sup> degree burn is suspected, the more advanced dressing material is unnecessary, though surgical interven-

tion should be performed early on. Our proposed algorithm for when to start dressing with hydrofiber dressing is shown in Fig. 3.



**Fig. 3** - Algorithm for starting treatment with Aquacel Ag® for partial thickness burn

Our explanation for more frequent redressing when using the dressing on the injury day may be attributed to more secretion noticed on the first days post injury or to less adherence to the blisters and burnt epidermis that still covers some of the burnt area upon first dressing procedure.

To conclude, according to our experience and previous studies,<sup>15-20</sup> Aquacel Ag® is the favorable dressing material for the pediatric population suffering from partial thickness burns. It is cost-effective, reduces the need for painful dressing changes and anesthesia, and saves staff working hours while reducing the length of hospitalization. The proper use of this dressing is for it to be initiated on the 1<sup>st</sup> day after burn, or on the 2<sup>nd</sup> day when a deep 2<sup>nd</sup> degree burn is suspected. Until then a standard topical preparation should be used.

## BIBLIOGRAPHY

- 1 Serour F, Gorenstein A, Boaz M: Characteristics of thermal burns in children admitted to an Israeli pediatric surgical ward. *Isr Med Assoc J*, 10: 282-6, 2008.
- 2 D'Souza AL, Nelson NG, McKenzie LB: Pediatric burn injuries treated in US emergency departments between 1990 and 2006. *Pediatrics*, 124: 1424-30, 2009.
- 3 Rawlins JM, Khan AA, Shenton AF, Sharpe DT: Epidemiology and outcome analysis of 208 children with burns attending an emergency department. *Pediatr Emerg Care*, 23(5): 289-293, 2007.
- 4 Spinks A, Wasiak J, Cleland H, Beben N et al.: Ten-year epidemiological study of pediatric burns in Canada. *J Burn Care Res*, 29(3): 482-488, 2008.
- 5 Cartotto R: Topical antimicrobial agents for pediatric burns. *Burn Trauma*, 5: 33, 2017.
- 6 Gonzalez R, Shanti CM: Overview of current pediatric burn care. *Semin Pediatr Surg*, 24(1): 47-49, 2015.
- 7 Barnea Y, Weiss J, Gur E: A review of the applications of the hydrofiber dressing with silver (Aquacel Ag) in wound care. *Ther Clin Risk Manag*, 6: 21-27, 2010.
- 8 Bowler PG, Jones SA, Walker M, Parsons D: Microbicidal properties of a silver-containing hydrofiber dressing against a variety of burn wound pathogens. *J Burn Care Rehabil*, 25(2): 192-196, 2004.
- 9 Castellano JJ, Shafii SM, Ko F, Donate G et al.: Comparative evaluation of silver-containing antimicrobial dressings and drugs. *Int Wound J*, 4(2): 114-122, 2007.
- 10 Caruso DM, Foster KN, Blome-Eberwein SA, Twomey JA et al.: Randomized clinical study of Hydrofiber dressing with silver or silver sulfadiazine in the management of partial-thickness burns. *J Burn Care Res*, 27(3): 298-309, 2006.
- 11 Bowler PG, Jones SA, Davies BJ, Coyle E: Infection control properties of some wound dressings. *J Wound Care*, 8(10): 499-502, 1999.
- 12 Jones SA, Bowler PG, Walker M, Parsons D: Controlling wound bioburden with a novel silver-containing Hydrofiber dressing. *Wound Repair Regen*, 12(3): 288-294, 2004.
- 13 Waring MJ, Parsons D: Physico-chemical characterisation of carboxymethylated spun cellulose fibres. *Biomaterials*, 22(9): 903-912, 2001.
- 14 Jones SA, Bowler PG, Walker M, Parsons D: Controlling wound bioburden with a novel silver-containing Hydrofiber dressing. *Wound Repair Regen*, 12(3): 288-294, 2004.
- 15 Saba SC, Tsai R, Glat P: Clinical evaluation comparing the efficacy of aquacel ag hydrofiber dressing versus petrolatum gauze with antibiotic ointment in partial-thickness burns in a pediatric burn center. *J Burn Care Res*, 30(3): 380-385, 2009.
- 16 Lau CT, Wong KKY, Tam P: Silver containing hydrofiber dressing promotes wound healing in paediatric patients with partial thickness burns. *Pediatr Surg Int*, 32(6): 577-581, 2016.
- 17 Brown M, Dalziel SR, Herd E, Johnson K, Wong She R et al.: Randomized controlled study of silver-based burns dressing in a pediatric emergency department. *J Burn Care Res*, 37(4): e340-7, 2016.
- 18 Lohana P, Potokar TS: Aquacel ag® in paediatric burns - a prospective audit. *Ann Burns Fire Disasters*, 19(3): 144-147, 2006.
- 19 Paddock HN, Fabia R, Giles S, Hayes J et al.: A silver-impregnated antimicrobial dressing reduces hospital costs for pediatric burn patients. *J Pediatr Surg*, 42(1): 211-213, 2007.
- 20 Shekter CC, Van Vliet MM, Krishnan NM, Garner WL: Cost-effectiveness comparison between topical silver sulfadiazine and enclosed silver dressing for partial-thickness burn treatment. *J Burn Care Res*, 35(4): 284-290, 2014.
- 21 Moyer CA: Some effects of 0.5 per cent silver nitrate and high humidity upon the illness associated with large burns. *J Natl Med Assoc*, 57(2): 95-100, 1965.
- 22 Lansdown ABG: Silver. I: Its antibacterial properties and mechanism of action. *J Wound Care*, 11(4): 125-130, 2002.
- 23 Percival SL, Bowler PG, Russell D: Bacterial resistance to silver in wound care. *J Hosp Infect*, 60(1): 1-7, 2005.



# IAHM

## International Association for Humanitarian Medicine Chisholm - Gunn

On the INTERNET <http://www.iahm.org>

for:

Notice board – Mission – Journal – Search engine – Links to related sites